Practical TikZ tutorial

Pol del Aguila Pla
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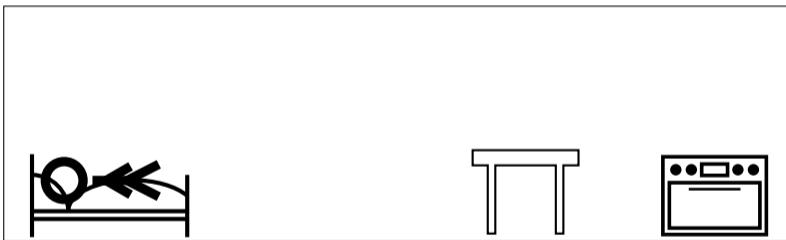poldap@kth.se, people.kth.se/∼poldap
Fork this tutorial on GitHub: github.com/poldap/tikz-tutorial

January 2019

Motivating example - 0 words introduction

- The interest of a research topic in a simple animation.
- Creativity and clear communication.

The Internet of Things

Introduction to an old presentation - will not be published.

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- The interest of a research topic in a simple animation.
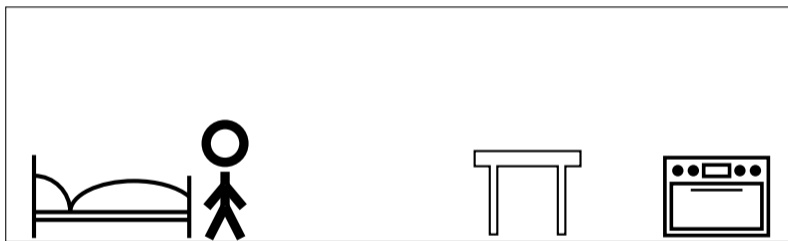- Creativity and clear communication.

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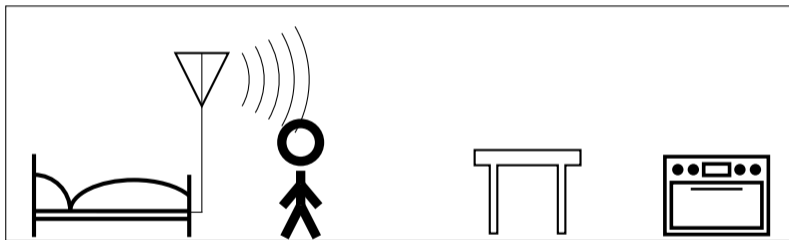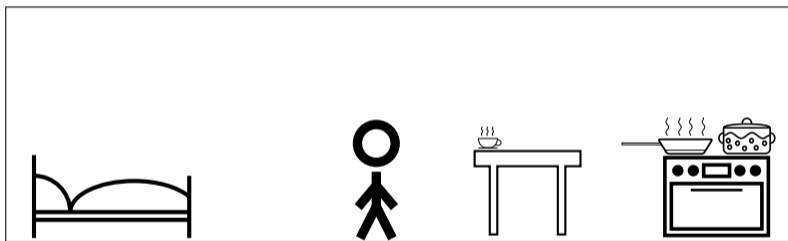- ▶ Creativity and clear communication.

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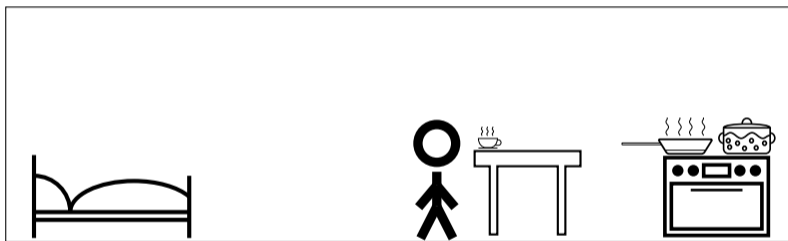

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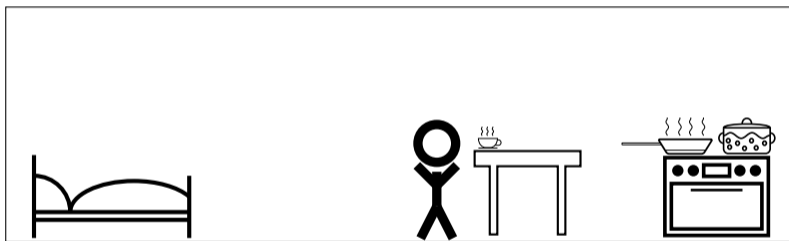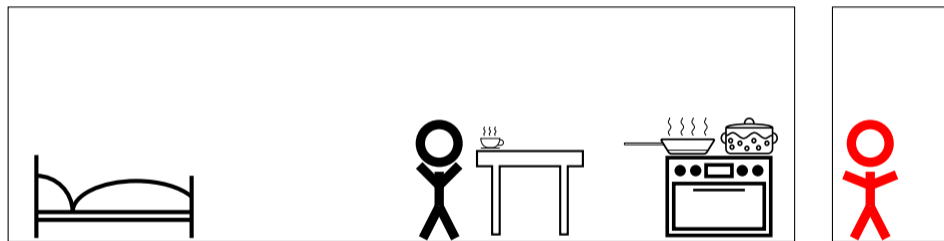- ▶ Creativity and clear communication.

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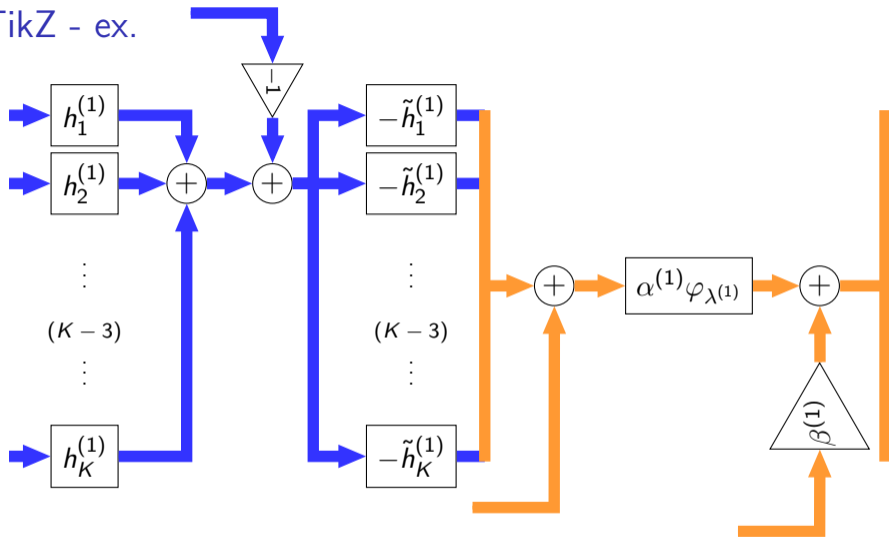- Creativity and clear communication.

The Privacy-Aware Internet of Things

Introduction to an old presentation - will not be published.

Simply TikZ - ex.

Part of P. del Aguila Pla, V. Saxena, and J. Jaldén, "SpotNet — Learned iterations for cell detection in image-based immunoassays," , Accepted in 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI), Apr. 2019

Simply TikZ - Basics

- Diagram mode keywords: `node`, `anchor`, `draw`, `rotate`, `opacity`, `--`, `-- ++`, `-`, `->`, `<-`, `thick`, `very thin`, `dashed`, `dotted`, `dashdotted`, `midway`, `below`, `fill`

Simply TikZ - Basics

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- `\node[draw] (a) at (-1,0) {[A]}; \node (b) at (1,0) {[B]};`
  `\draw[<->] (a) -- (b);`

$$\boxed{[A]} \longleftrightarrow [B]$$

Simply TikZ - Basics

- Diagram mode keywords: `node`, `anchor`, `draw`, `rotate`, `opacity`, `--`, `-- ++`, `-`, `->`, `<-`, `thick`, `very thin`, `dashed`, `dotted`, `dashdotted`, `midway`, `below`, `fill`

- `\node[draw] (a) at (-1,0) {[A]}; \node (b) at (1,0) {[B]};`
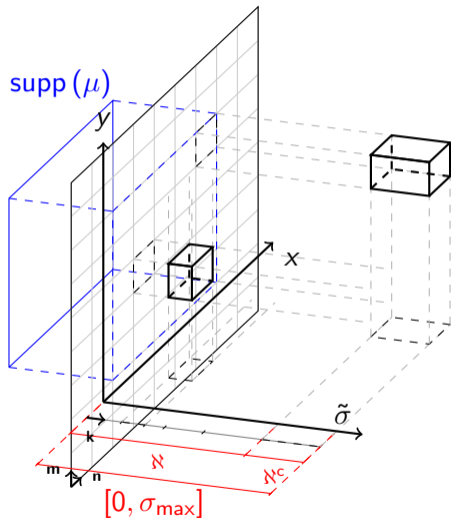 `\draw[<->] (a) -- (b);`

  [A] ⟵⟶ [B]

- `\node[draw,shape=circle,rotate=90] at (-1,0) {$1$};`
  `\node[draw=blue,very`
  `thick,shape=circle,fill=red,opacity=0.5,anchor=south] (b) at`
  `(1,0) {$2$}; \draw[-latex,thick,dashdotted] (a.south) --++`
  `(0,-0.4) --++ (1,0) -- (b.west) node[midway,above,rotate=60]`
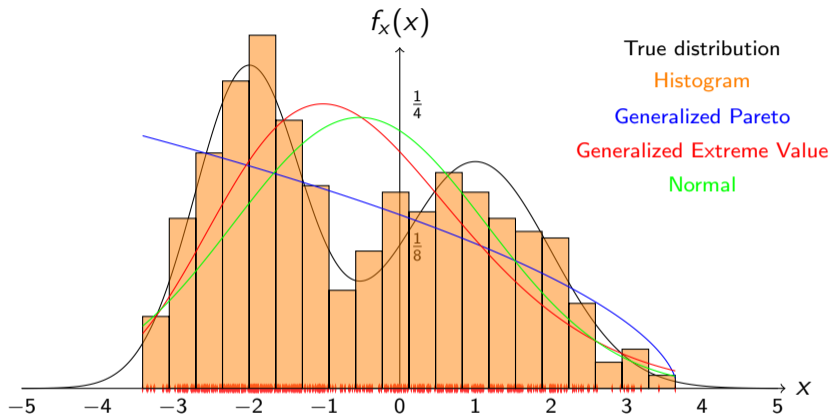 `{middle};`

Simply TikZ + 3D + loops - ex.

sensor's grid

supp (μ)

y

x

$\tilde{\sigma}$

k

m n

$\aleph$ $\aleph^c$

$[0, \sigma_{\max}]$

▶ More concepts and keywords:
  `\def`, `\foreach`,
  `\pgfmathsetmacro`,
  `gray!40!blue`,
  `\newcommand`

Part of P. del Aguila Pla and J. Jaldén,
"Cell detection by functional inverse dif-
fusion and non-negative group sparsity—
Part I: Modeling and Inverse problems,"
IEEE Transactions on Signal Processing,
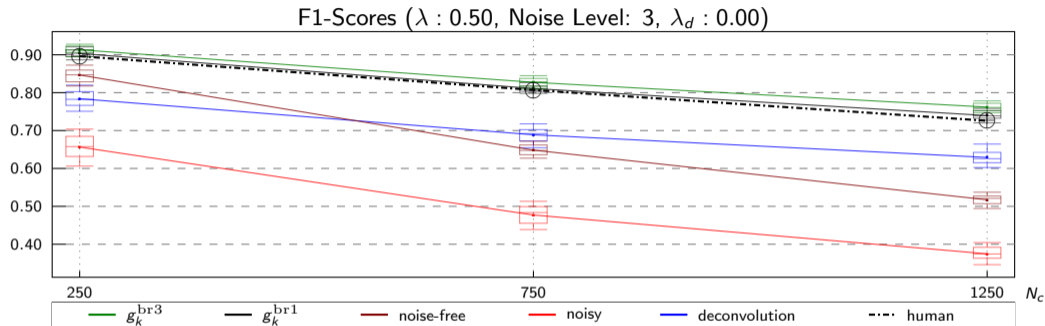vol. 66, no. 20, pp. 5407–5421, Oct. 2018

Simply TikZ for plotting

- More concepts and keywords: `plot file`, `smooth`, `ybar`, `plot function`, `domain`, `samples`

Part of an old presentation - will not be published.

Simply TikZ scripted plotting - ex.

F1-Scores ($\lambda : 0.50$, Noise Level: 3, $\lambda_d : 0.00$)

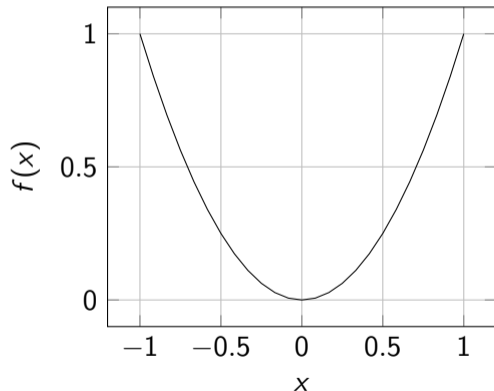Legend: g_k^{br3} — g_k^{br1} — noise-free — noisy — deconvolution — human

► Easily scripted

Part of P. del Aguila Pla and J. Jaldén, "Cell detection by functional inverse diffusion and non-negative group sparsity—Part II: Proximal optimization and Performance evaluation," *IEEE Transactions on Signal Processing*, vol. 66, no. 20, pp. 5422–5437, Oct. 2018
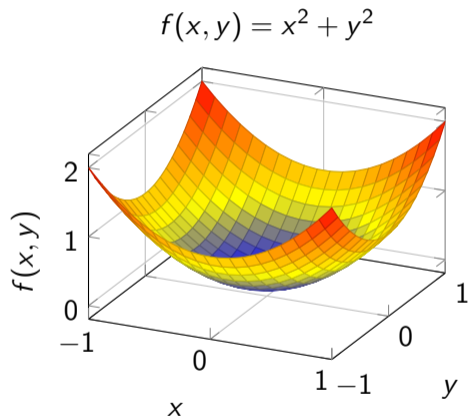
PGFplots - Easier plotting

$$f(x) = x^2$$


```
\begin{axis}[ title = {$f(x) =
x^2$},grid = major,xlabel =
{$x$},ylabel = {$f(x)$},]
\addplot[domain = -1:1] {x^2};
\end{axis}
```

PGFplots - Easier 3D plotting

$f(x,y) = x^2 + y^2$

```
\begin{axis}[ title = { $f(x,y) =
x^2 + y^2$}, grid = major, xlabel
= {$x$}, ylabel =
{$y$},zlabel={$f(x,y)$},]
\addplot3[surf,domain =
-1:1,samples=20] {x^2+y^2};
\end{axis}
```

PGFplots from Python (matplotlib2tikz)

```python
import numpy as np
import matplotlib.pyplot as plt
import matplotlib2tikz as tikz
x = np.arange(0, 4 * np.pi, 0.01); y = np.sin( x ) + 0.2 * np.random.randn( x.size )
plt.plot( x, y, 'r-' ); plt.xlabel(r'$x$'); plt.ylabel('Signal'); plt.title('Noisy signal');
tikz.save( 'example.tex' )
```
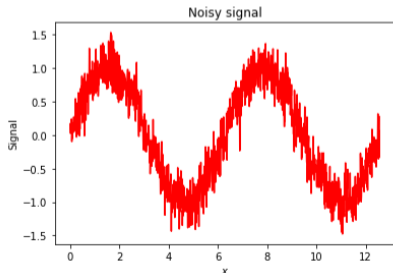
```
=======================================================
Please add the following lines to your LaTeX preamble:

\usepackage[utf8]{inputenc}
\usepackage{fontspec} % This line only for XeLaTeX and LuaLaTeX
\usepackage{pgfplots}
=======================================================
Horizontal alignment will be ignored as no 'x tick label text width' has been passed in the 'extra' parameter
Horizontal alignment will be ignored as no 'y tick label text width' has been passed in the 'extra' parameter
```
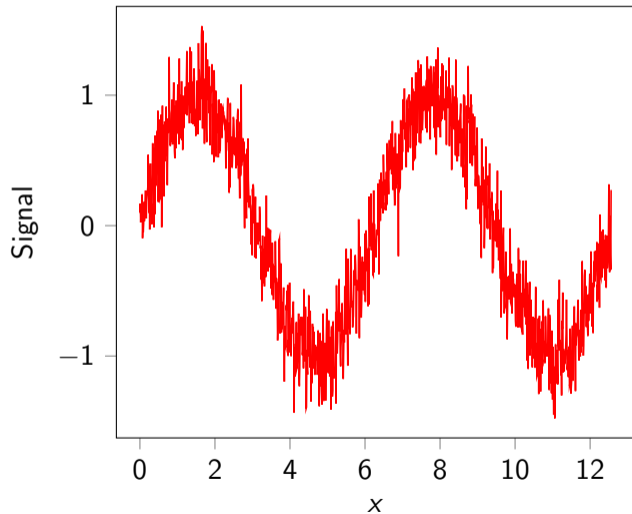
PGFplots from Python (matplotlib2tikz)
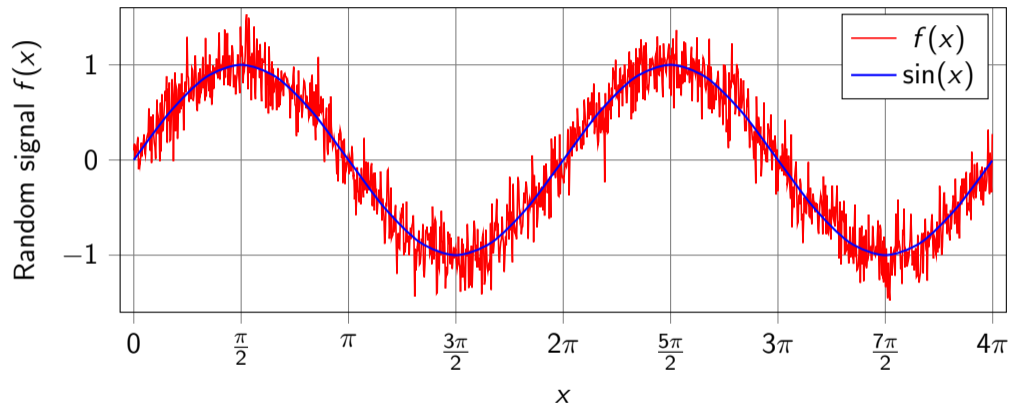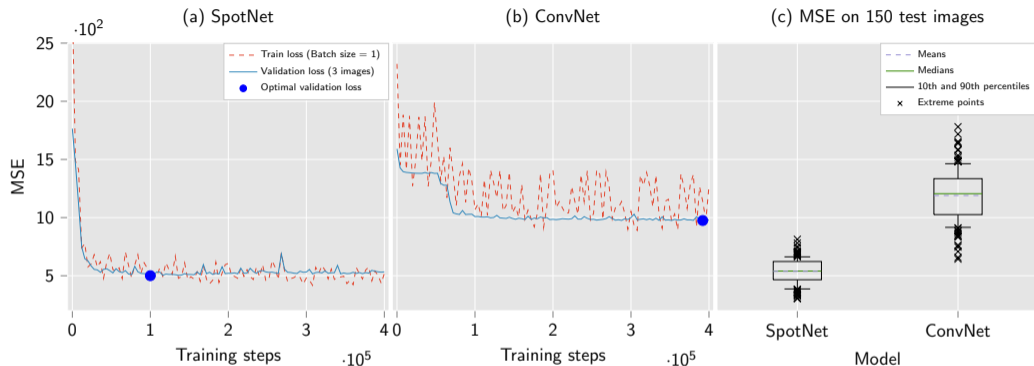

Noisy signal

`\input{figs/example}`

PGFplots from Python (matplotlib2tikz)

Noisy signal $f(x) = \sin(x) + w(x)$ with $w(x) \sim \mathcal{N}(0, 0.2)$

- less than 5 minutes of work away (compare `figs/example.tex` with `figs/example_improved.tex`).

PGFplots from Python (matplotlib2tikz) - ex.

(a) SpotNet (b) ConvNet (c) MSE on 150 test images

Explore github.com/poldap/SpotNet to see the generation of these figures in Python.

Practical TikZ Tutorial - Remarks

- ▶ Use the same styles (fonts, font sizes, math symbols, etc.) across your papers, i.e., in your figures, in your text, etc.
- ▶ Work only with scalable graphics
- ▶ Put no limits on the drawing possibilities, promote creativity and clear communication
- ▶ Re-use drawings and figures, get your time back
- ▶ Use TikZ :-D

A word of warning: local compilation will require `pdflatex -shell-escape` or `pdflatex --shell-escape` (depending on your LaTeX distribution) for many of the examples. Compliation time will benefit from the use of `\usetikzlibrary{external} \tikzexternalize` in the preamble of your document.